IND PK

INSTALLATION AND OPERATING INSTRUCTIONS

TENNEY
ENVIRONMENTAL
EQUIPMENT

Serial No. 5991

Model No. TTUF-100240

MP MASTER
MA29083

Tenney
ENGINEERING, INC.

PHONE MURDOCK 6-7870
REFRIGERATION AND ENVIRONMENTAL EQUIPMENT
MEMBER OF ENVIRONMENTAL EQUIPMENT INSTITUTE

FORM AD-1

TENNEY ENGINEERING, INC.
1090 SPRINGFIELD ROAD
UNION, NEW JERSEY

INSTALLATION AND OPERATING INSTRUCTIONS

FOR

TENNEY MODEL - TTUF-100240

ITT INDUSTRIAL LABORATORIES
3700 E. PONTIAC STREET
FORT WAYNE, INDIANA

P.O. NO. 2-36387

TENNEY SERIAL NO. 5991

INCLUDED:

Warranty
Temperature Conversion Chart
Cutting Cams for Program Instruments
Low Temperature Refrigeration System Addendum
Bristol Instruction Book No. T500FT
Drawing Nos. E - 178 - 2C
E - 179 - 2A
E - 181 - 2A
E - 186 - 2B
E - 344 - 3D
R - 690 - 2K
E - 29 - 1B

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I N S T A L L A T I O N

SETTING UP THE CHAMBER

The test chamber should be set up level on a floor that has been suitably reinforced, if necessary, to take the required load. Sufficient clearance should be left completely around the chamber, to allow for door swing, and to facilitate servicing of the various parts of the chamber.

Chambers with air cooled refrigeration units should be located to permit free circulation of air to and from the unit.

Units equipped with water cooled refrigeration units must not be located in areas where freezing temperatures may occur.

INSTRUMENT PANEL

In the event the chamber is equipped with a remote instrument panel, this procedure should be followed:

1. Locate the panel in the desired position and fasten it securely to the floor with lag screws or some similar type of fastener.

   The location is only limited by the length of the instrument bulb capillaries. The control wiring may be lengthened if it is desired to move the panel to a more distant location providing the instrument capillaries are long enough.

2. Mount the control instrument bulbs by means of the bracket in front of the chamber fan.

3. Seal the instrument bulb penetrations by means of the stoppers provided. Make certain the inside and outside stoppers are both tight.

4. Connect the control wiring between the chamber and the instrument panel. The wires are both color coded and numbered so there should be no difficulty in making the proper connections. The chamber wires are enclosed in a flexible piece of Greenfield Cable with the proper connector to attach it to the junction box beneath the instruments. The wires themselves have spade type connectors which fit a terminal strip in the junction box.

I N S T A L L A T I O N continued

CONNECTING SERVICES

Electrical Connections

Reference to the attached wiring diagram will indicate the type of power lines to be brought to the various locations on the test chamber. The power schedule is made up to show the voltage and phase requirements, the current consumption, and also the recommended fuse size for each circuit. The location of each circuit is shown by the appropriate letter on the wiring diagram, and can be located on the test chamber by referring to the tags.

These various connections are kept separated so that each circuit can be fed through separate fused safety disconnect switches in accordance with standard procedure.

Condenser Water Line

If the unit is equipped with a water cooled refrigeration system, there are two water connections to be made. A water supply and a drain connection, check the Refrigeration Schematic Drawing for the line size and flow required. The water supply connection should be made to a reasonably cool water supply of at least 40 PSIG. It is recommended that a shut-off valve be installed in the supply line.

Run the drain connection to an open drain.

If a cooling tower is available, the inlet and outlet connections can be made to it, providing the water regulator valve is removed, and the condenser recircuited. Units ordered for cooling tower operation will be piped accordingly at the factory.

Refrigeration Connections

Self-contained test chambers have compressors, and refrigeration equipment completely connected and no further connections must be made other than electrical and water connections as previously mentioned.

Spring mounted refrigeration compressors are shipped fastened down. Slack off the shipping bolts until the unit moves freely.

A P P E N D I X B continued

CONFLICTING SERVICES

Telephone Companies

I N S T A L L A T I O N continued

CONNECTING SERVICES continued

Refrigeration Connections continued

With most test chambers, the refrigerant charge is pumped down into the receiver and the valve is closed prior to shipment. When this is done it will be indicated by a tag attached on the receiver in a prominent location. This valve, as well as any others that may be similarly marked, should be opened before starting any test runs.

IMPORTANT: Before operating this equipment, have the refrigeration system leak-tested with a halide torch by a competent refrigeration serviceman, experienced in low temperature applications, to find and repair any leaks that may have developed in transit.

REMOVAL OF TAGS

Before shipment, tags are attached to various accessories and points of service locations. For the guidance of maintenance and operating personnel, it is recommended that the maintenance man and the operator both check each tag before removal to make certain that there will be no misunderstanding regarding the functions of these items.

E Q U I P M E N T

CONTROLLERS

The instrument furnished with the chamber is used to control the dry bulb temperature within the work space. The temperature setting is made by means of a knob provided on the instrument.

The instruction manual covering the instruments should be referred to for detailed information regarding the manufacturers' recommendation for the operation and maintenance of the instruments. United Electric instruments are not provided with manuals.

CONTROL PANEL

The toggle switches mounted on the Control Panel are the one-hole mounting type, manufactured by Cutler-Hammer. The catalog number of these switches will be found on the wiring diagram of the Control Panel.

The neon type pilot lights are a long life unit, with soldered terminal connections. They are manufactured by the Industrial Devices Company.

E Q U I P M E N T

CONTROL PANEL continued

Replacement lights are:

110 volt systems Model - OMNI-Glow 1040A-3-110
220 volt systems Model - OMNI-Glow 1040A43-220

All control switches have a nameplate indicating the switch function. The pilot lights are a ready indication that a circuit is energized.

It is suggested, that the operator familiarize himself with the various switches and control elements of this equipment, placing at his disposal the full capability of the unit.

NOTE: Items marked by * are optional features. Switch or electrical component symbols refer to the Electric Schematic Drawing.

Control Switch (Single Stage Refrigeration System)

"ON" - Energizes the control system and starts the conditioner fan motors. Permitting further selection of chamber functions through the control instrument.

Control Switch (Cascade Refrigeration)

"ON" - Energizes the control system, starts the conditioner fan motors, and the condenser fan motors on air-cooled condensers, and provides the following automatic features;

PS3 (R-22 Compressor Cut-In) - This switch is set below the maximum R-13 static charge pressure to start the R-22 compressor. When the Control Switch is energized the R-22 compressor starts, causing the cascade condenser to cool. This cooling effect reduces the R-13 pressure to the value set on PS3.

Heat Switches - Heat #1 and Heat #2

Two heat switches are provided so the operator can have a selection of heat input for operation under various conditions.

Each switch operates its own LC - Line Contactor and heater bank. Thus three values of heat are available.

Heat #1	Alone
Heat #2	Alone
Heat #1 and #2	Together

E Q U I P M E N T continued

CONTROL PANEL continued

Cooling Switch (Single Stage Refrigeration System)

"ON" - A DPST switch one side completes a circuit from the cooling demand of the temperature control instrument to the cooling control circuit. Motor Compressor M1 is energized, Solenoid SV1 opens to establish flow of refrigerant through the conditioner cooling coil.

The other side of this switch starts the condenser fan motor on air cooled units, and energizes the *window heaters.

Ambient Cooling and Sub-Zero Cooling Switch
Cascade Refrigeration Systems

A DPDT with center-off switch completes a circuit on cooling demand of the dry bulb controller.

In the AMBIENT position energizes:

Cooling control circuit, motor compressor M1, and Solenoid SV1, to establish a refrigerant circuit through the ambient cooling coil.

Select the SUB-ZERO COOLING position for temperatures below 0°F. or design maximum low temperature. Operates the R-13 system establishing an R-13 refrigerant circuit through the main cooling coil.

Simultaneously, R-22 circuits are switched and this system functions as a cascade condenser for R-13 .

*Window heaters are automatically energized.

*Chamber Light

A light switch is provided on the Control Panel when the chamber is equipped with an interior light. The light switch is on the lamp fixture, when it is mounted on the exterior.

*Panel Light

This switch "turns on" a fluorescent fixture illuminating the instruments on the *Console.

E Q U I P M E N T continued

HEATERS

Electric air heaters are provided inside the chamber for the purpose of raising the dry bulb temperature to the required control point. These heaters consist of resistance type nichrome element heaters.

The electric air heaters are wired in separate circuits to provide a selection of heat input, thus, a heating rate can be chosen to balance the load and provide close control of temperatures. All heaters are wired into the control circuit so that accidental over-ride of the control point is impossible.

Provision is made to prevent excessive temperature rise in the event of failure of the control instrument. A thermostatic high temperature cut-out is wired into the heater circuit so that the heaters will be shut off should the temperature go slightly above the maximum cabinet design temperature.

The thermostat should not require adjustment as it has been set during test.

FAN

The air circulator consists of either one or two fans located within the chamber at the rear of the work space.

Air is drawn from the work space into the conditioning compartment where it is heated, or cooled, as required, and then discharged into the work space. The fan (or fans) should operate at any time tests are being performed, being automatically energized by the "CONTROL" Switch.

The fan motors are mounted externally to protect them against the varying chamber environment.

COMPRESSORS AND REFRIGERATION SYSTEM

Single stage or cascade systems are equipped with hermetic compressors. The units are provided with current and thermal overload protection.

Both types of systems include pressurestats as cut-outs in the event excessive system pressures are encountered. An additional system safety feature is a Fusible Plug rated at 210°F. Some systems may include a Pressure Relief Valve.

E Q U I P M E N T continued

COMPRESSORS AND REFRIGERATION SYSTEM continued

A valved pressure tap manifold is provided to facilitate, servicing the refrigeration system.

Refrigerant Circuit (Single Stage)

The Freon-22 leaves the receiver, flows through the drier, sight glass, to the expansion valve. This valve meters the liquid refrigerant into the evaporator. From the evaporator the refrigerant returns to the compressor, in the vapor state via the suction line.

Refrigerant Circuit (Cascade System)

See Addendum #1, for description of the R-22, R-13 cascade system.

CONTROL ELEMENT

The temperature sensing element consists of a thermocouple or thermometer bulb depending on the type of instrumentation furnished with the chamber. This element is located in the air stream.

THE OPERATION OF CONDITIONING EQUIPMENT

The TENNEY Test Chamber is designed and constructed to provide close and accurate control temperature throughout the specified range of the test chamber.

The control setting is resolved into a sensible dry bulb temperature.

Ambient temperature pertains to an equilibrium temperature in the chamber when the conditioning apparatus is not operative. Ambient temperature may be higher than the outside room temperature when there is a heat dissipating object under test in the chamber.

Sensible, or dry bulb temperatures, higher than ambient are achieved by circulating air over the main electric air heaters which are controlled by the dry bulb recorder controller through heat switches on the Control Panel.

All heat switches may be closed to effect a quick change, but only a portion of the heat capacity may be required to maintain any temperature setting after the control point is reached.

Extreme low temperatures are achieved by operation of the main finned coil serving as an evaporator for the main refrigeration system.

THE OPERATION OF CONDITIONING EQUIPMENT continued

For specific conditions, effort should be made to set up control through either heating or cooling, rather than cycle between the two. This will be feasible at most conditions except those near ambient.

P R E V E N T I V E M A I N T E N A N C E

REFRIGERATION SYSTEM

It is recommended that the refrigeration system be inspected periodically by a refrigeration serviceman experienced in environmental and low temperature applications.

Check refrigerant sight glass for proper charge. If a persistant bubbling is indicated (indicating a shortage of refrigerant) check the complete system for leaks, particularly joints that cycle with temperature, expansion valve flange gaskets, threaded connections on hgih side etc.

REFRIGERATION COMPRESSORS

The compressors are permanently lubricated hermetic units. In the event that oil should leak out of the unit oil must be added;

NOTE: this must be done by a refrigeration serviceman. The oil used in the compressors is Suniso 3G oil.

Suniso oils are manufactured by the Sun Oil Company and are available at most Refrigeration Equipment wholesalers.

CONDENSERS (AIR COOLED)

Inspect the condensers by removing the front panel of the lower cabinet. Lint, dust or dirt will restrict the passage of air through the condenser resulting in a loss of cooling capacity.

They are cleaned best by blowing through with compressed air or using a vacuum cleaner.

FAN MOTORS

The conditioner fan motors have sleeve bearings, oil with SAE 30 oil every six (6) months.

Condenser fan motors are permanently lubricated.

LOW TEMPERATURE REFRIGERATION SYSTEM

The low temperature refrigeration system is a cascade system, consisting of a Freon-13 low stage system and a Freon-22 high stage system. The Freon-13 low stage system compressor operates in conjunction with the main finned coil located in the conditioning compartment.

Operation of the Freon-13 system is as follows:

Liquid Freon-13 leaves the cascade condenser and flows through an expansion valve into the evaporator. Suction gas from the evaporator returns to the compressor or compressors. The discharge gas flows through a water or air-cooled coil, called a desuperheater, where a considerable portion of the heat is removed, then through an oil separator. The gas then flows into the cascade condenser where it is condensed into a liquid.

An expansion tank is provided in low volume systems for the following purposes:

1. During shut down periods it serves as a resevoir for the Freon-13 vapor, to prevent excessively high standby pressures.

2. During operation it acts as a load limiting device allowing high pressure refrigerant to be by-passed into the expansion tank through a pressure regulating valve, thereby reducing the compressor load, which in turn will result in lower discharge pressures. When the pressure regulating valve is in its normal position, the refrigerant stored in the expansion tank then becomes available to the system through a capillary tube from the expansion tank to the Freon-13 suction line.

This entire Freon-13 refrigeration system is so designed that its capacity is sufficient to contain the entire refrigerant charge in the form of gas without a build-up of excessively high pressures. During operation, the gas is drawn from the evaporator and also the expansion tank, then is compressed and condensed and a sufficient quantity of liquid refrigerant is then available to form a seal in the condenser and to provide a solid liquid filled line to the expansion valve.

Charging of this system with refrigerant should be done in strict accordance with the instructions. First, the entire system should be thoroughly leak tested and then evacuated to 1 MM Hg., and this vacuum should be held in a closed system for 24 hours to ensure that there are no leaks. Then Freon-13 refrigerant should be charged into the low side of the system until the head pressure shows the proper reading for the existing ambient temperature as noted in the following table. The system should be gas charged only. (Do not invert the Freon-13 drum). Time should be allowed for the pressure to balance throughout the system.

Ambient Temperature °F.	MAXIMUM Charging Pressure (PSIG)
100	150
90	145
80	140
70	135
60	130
50	125

IMPORTANT: Do not exceed the above pressures when charging and never charge the system while any part of it is cold.

Operation of the Freon-22 system is as follows:

Liquid Freon-22 leaves the condenser-receiver and flows through sight glass, drier, etc., then flows through a heat exchanger, a solenoid valve and through an expansion valve into the cascade condenser.

Suction gas from the cascade condenser returns to the heat exchanger, to the suction valve of the Freon-22 compressor. Discharge gas from this compressor passes into the Freon-22 condenser-receiver where it is condensed to a liquid.

AMBIENT REFRIGERATION SYSTEM

This system is used when operating conditions require only a moderate amount of cooling. This system is automatically brought into operation when the ambient cooling switch is closed. The auxiliary finned coil in the conditioning compartment is used instead of the main finned coil and the Freon-22 compressor which acts as a condenser for Freon-13 during sub-zero operation is automatically switched over by means of solenoid valves from the cascade condenser to the auxiliary finned coil. The solenoid valve, ahead of the expansion valve, feeding the cascade condenser is de-energized and the liquid Freon-22 flow is then diverted through another solenoid valve to the auxiliary finned coil.

CUTTING CAMS FOR PROGRAM INSTRUMENTS

When laying out program cams for either Brown or Bristol instruments, it will be necessary to apply a correction factor to compensate for the radius of the roller on the cam follower arm, in order to obtain accurate reproduction of specified cycles. Instruments as received from the factory are generally calibrated to the center of the cam follower roller, and a cam cut to the exact temperature required will introduce an error that cannot be completely eliminated by adjusting the cam follower arm.

All cams should, therefore, be laid out and cut along a line that is 3/32" below the desired temperature. The sketch shows the desired temperature for a portion of the JAN-C-25 Cycle, and also the line along which the cam should be cut. Other cycles should be laid out in a similar manner.

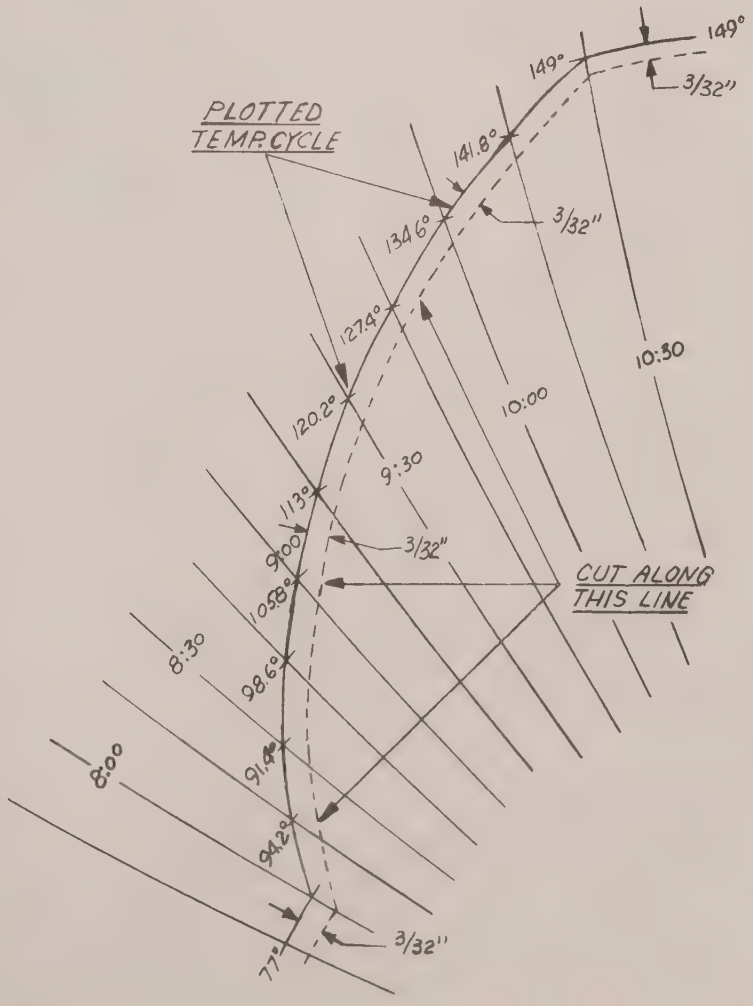
EXAMPLE

Required Cycle:

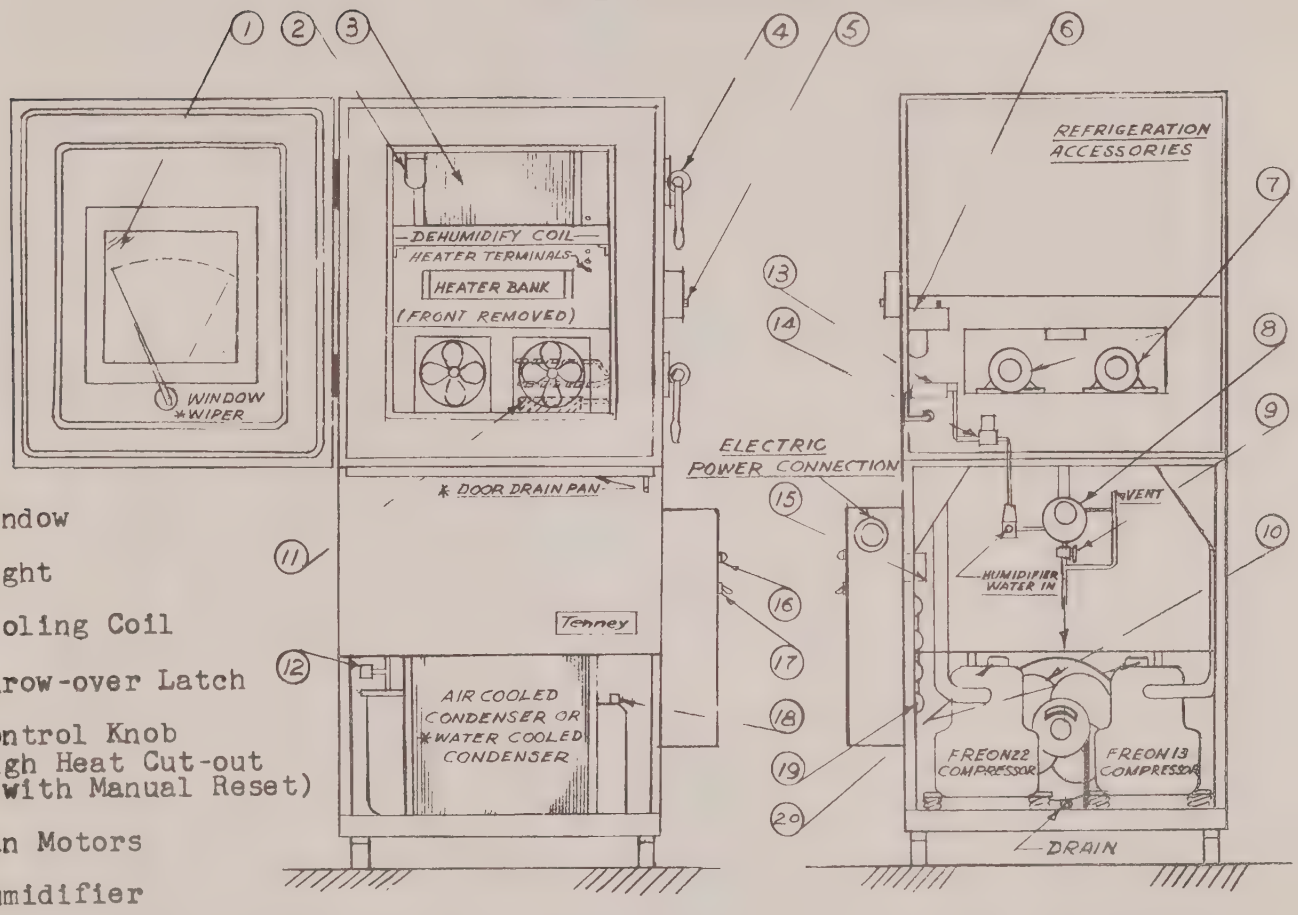
Rise from ≠77°F. to ≠149°F
in 2½ hrs. at a uniform rate.

Plot points as follows:

TIME	TEMP
8:00 AM	77.0°F.
8:15	84.2
8:30	91.4
8:45	98.6
9:00	105.8
9:15	113.0
9:30	120.2
9:45	127.4
10:00	134.6
10:15	141.8
10:30	149.0



TENNEY TTUF & TTUFR



*1 Window

*2 Light

3 Cooling Coil

4 Throw-over Latch

5 Control Knob

6 High Heat Cut-out (with Manual Reset)

7 Fan Motors

*8 Humidifier

*9 Humidifier Drain Valve

*10 Condenser Fan & Motor

*11 Wet Wick Pan

12 Freon-22 Fusible Plug

13 Wick Pan Water Level Control

14 Wick Pan Solenoid (On Units Rated above 200°F.)

15 Refrigeration (Pressure Controls Panel)

16 Pilot Lights.

17 Control Switches

18 Fusible Plug

19 Service Valve Manifold

20 Motor Compressor Overload.

*Indicates optional features.

NOTE:

a) Cascade Refrigeration shown.

b) Single Stage Refrigeration system is identical except, less Freon-13 compressor.

c) Water cooled condenser not shown. If unit is equiped with a water cooled condenser, the inlet and drain are along side the chamber drain connection.

d) If an *Instrument Console is ordered with the unit, the pilot lights and control switches are on the console.

Temperature Conversion Chart

WHEN CONVERTING FROM FAHRENHEIT TO CENTIGRADE:
LOCATE TEMPERATURE READING IN CENTER COLUMN.
READ CENTIGRADE TEMPERATURE IN LEFT COLUMN.

WHEN CONVERTING FROM CENTIGRADE TO FAHRENHEIT:
LOCATE TEMPERATURE READING IN CENTER COLUMN.
READ FAHRENHEIT TEMPERATURE IN RIGHT COLUMN.

-459.4	TO	-70	-69	TO	0	1	TO	69	70	TO	139	140	TO	290	300	TO	1000
C.		F.	C.		F.	C.		F.	C.		F.	C.		F.	C.		F.
-273	-459.4		-56.1	-69	-92.2	-17.2	1	33.8	21.1	70	158.0	60.0	140	284.0	149	300	572
-268	-450		-55.5	-68	-90.4	-16.7	2	35.6	21.7	71	159.8	60.6	141	285.8	154	310	590
-262	-440		-55.0	-67	-88.6	-16.1	3	37.4	22.2	72	161.6	61.1	142	287.6	160	320	608
-257	-430		-54.4	-66	-86.8	-15.6	4	39.2	22.8	73	163.4	61.7	143	289.4	166	330	626
-251	-420		-53.9	-65	-85.0	-15.0	5	41.0	23.3	74	165.2	62.2	144	291.2	171	340	644
-246	-410		-53.3	-64	-83.2	-14.4	6	42.8	23.9	75	167.0	62.8	145	293.0	177	350	662
-240	-400		-52.8	-63	-81.4	-13.9	7	44.6	24.4	76	168.8	63.3	146	294.8	182	360	680
			-52.2	-62	-79.6	-13.3	8	46.4	25.0	77	170.6	63.9	147	296.6	188	370	698
			-51.7	-61	-77.8	-12.8	9	48.2	25.6	78	172.4	64.4	148	298.4	193	380	716
			-51.1	-60	-76.0				26.1	79	174.2	65.0	149	300.2	199	390	734
-234	-390		-50.6	-59	-74.2	-12.2	10	50.0	26.7	80	176.0	65.6	150	302.0	204	400	752
-229	-380		-50.0	-58	-72.4	-11.7	11	51.8	27.2	81	177.8	66.1	151	303.8	210	410	770
-223	-370		-49.5	-57	-70.6	-11.1	12	53.6	27.8	82	179.6	66.7	152	305.6	216	420	788
-218	-360		-48.9	-56	-68.8	-10.6	13	55.4	28.3	83	181.4	67.2	153	307.4	221	430	806
-212	-350		-48.4	-55	-67.0	-10.0	14	57.2	28.9	84	183.2	67.8	154	309.2	227	440	824
-207	-340		-47.8	-54	-65.2	-9.44	15	59.0	29.4	85	185.0	68.3	155	311.0	232	450	842
-201	-330		-47.3	-53	-63.4	-8.89	16	60.8	30.0	86	186.8	68.9	156	312.8	238	460	860
-196	-320		-46.7	-52	-61.6	-8.33	17	62.6	30.6	87	188.6	69.4	157	314.6	243	470	878
-190	-310		-46.2	-51	-59.8	-7.78	18	64.4	31.1	88	190.4	70.0	158	316.4	249	480	896
-184	-300		-45.6	-50	-58.0	-7.22	19	66.2	31.7	89	192.2	70.6	159	318.2	254	490	914
-179	-290		-45.0	-49	-56.2	-6.67	20	68.0	32.2	90	194.0	71.1	160	320.0	260	500	932
-173	-280		-44.4	-48	-54.4	-6.11	21	69.8	32.8	91	195.8	71.7	161	321.8	266	510	950
-169	-273	-459.4	-43.9	-47	-52.6	-5.56	22	71.6	33.3	92	197.6	72.2	162	323.6	271	520	968
-168	-270	-454	-43.3	-46	-50.8	-5.00	23	73.4	33.9	93	199.4	72.8	163	325.4	277	530	986
-162	-260	-436	-42.8	-45	-49.0	-4.44	24	75.2	34.4	94	201.2	73.3	164	327.2	282	540	1004
157	-250	-418	-42.2	-44	-47.2	-3.89	25	77.0	35.0	95	203.0	73.9	165	329.0	288	550	1022
-151	-240	-400	-41.7	-43	-45.4	-3.33	26	78.8	35.6	96	204.8	74.4	166	330.8	293	560	1040
-146	-230	-382	-41.1	-42	-43.6	-2.78	27	80.6	36.1	97	206.6	75.0	167	332.6	299	570	1058
-140	-220	-364	-40.6	-41	-41.8	-2.22	28	82.4	36.7	98	208.4	75.6	168	334.4	304	580	1076
-134	-210	-346	-40.0	-40	-40.0	-1.67	29	84.2	37.2	99	210.2	76.1	169	336.2	310	590	1094
-129	-200	-328															
-123	-190	-310	-39.4	-39	-38.2	-1.11	30	86.0	37.8	100	212.0	76.7	170	338.0	316	600	1112
-118	-180	-292	-38.8	-38	-36.4	-0.56	31	87.8	38.3	101	213.8	77.2	171	339.8	321	610	1130
-112	-170	-274	-38.3	-37	-34.6	0	32	89.6	38.9	102	215.6	77.8	172	341.6	327	620	1148
-107	-160	-256	-37.8	-36	-32.8	0.56	33	91.4	39.4	103	217.4	78.3	173	343.4	332	630	1166
-101	-150	-238	-37.2	-35	-31.0	1.11	34	93.2	40.0	104	219.2	78.9	174	345.2	338	640	1184
-95.6	-140	-220	-36.6	-34	-29.2	1.67	35	95.0	40.6	105	221.0	79.4	175	347.0	343	650	1202
-90.0	-130	-202	-36.1	-33	-27.4	2.22	36	96.8	41.1	106	222.8	80.0	176	348.8	349	660	1220
-84.4	-120	-184	-35.5	-32	-25.6	2.78	37	98.6	41.7	107	224.6	80.6	177	350.6	354	670	1238
-78.9	-110	-166	-35.0	-31	-23.8	3.33	38	100.4	42.2	108	226.4	81.1	178	352.4	360	680	1256
-73.3	-100	-148	-34.4	-30	-22.0	3.89	39	102.2	42.8	109	228.2	81.7	179	354.2	366	690	1274
-72.8	-99	-146.2	-33.9	-29	-20.2	4.44	40	104.0	43.3	110	230.0	82.2	180	356.0	371	700	1292
-72.2	-98	-144.4	-33.3	-28	-18.4	5.00	41	105.8	43.9	111	231.8	82.8	181	357.8	377	710	1310
-71.7	-97	-142.6	-32.8	-27	-16.6	5.56	42	107.6	44.4	112	233.6	83.3	182	359.6	382	720	1328
-71.1	-96	-140.8	-32.2	-26	-14.8	6.11	43	109.4	45.0	113	235.4	83.9	183	361.4	388	730	1346
-70.6	-95	-139.0	-31.7	-25	-13.0	6.67	44	111.2	45.6	114	237.2	84.4	184	363.2	393	740	1364
-70.0	-94	-137.2	-31.1	-24	-11.2	7.22	45	113.0	46.1	115	239.0	85.0	185	365.0	399	750	1382
-69.5	-93	-135.4	-30.6	-23	-9.4	7.78	46	114.8	46.7	116	240.8	85.6	186	366.8	404	760	1400
-68.9	-92	-133.6	-30.0	-22	-7.6	8.33	47	116.6	47.2	117	242.6	86.1	187	368.6	410	770	1418
-68.4	-91	-131.8	-29.5	-21	-5.8	8.89	48	118.4	47.8	118	244.4	86.7	188	370.4	416	780	1436
-67.8	-90	-130.0	-28.9	-20	-4.0	9.44	49	120.2	48.3	119	246.2	87.2	189	372.2	421	790	1454
-67.2	-89	-128.2	-28.3	-19	-2.2	10.0	50	122.0	48.9	120	248.0	87.8	190	374.0	427	800	1472
-66.6	-88	-126.4	-27.7	-18	-0.4	10.6	51	123.8	49.4	121	249.8	88.3	191	375.8	432	810	1490
-66.1	-87	-124.6	-27.2	-17	1.4	11.1	52	125.6	50.0	122	251.6	88.9	192	377.6	438	820	1508
-65.5	-86	-122.8	-26.6	-16	3.2	11.7	53	127.4	50.6	123	253.4	89.4	193	379.4	443	830	1526
-65.0	-85	-121.0	-26.1	-15	5.0	12.2	54	129.2	51.1	124	255.2	90.0	194	381.2	449	840	1544
-64.4	-84	-119.2	-25.5	-14	6.8	12.8	55	131.0	51.7	125	257.0	90.6	195	383.0	454	850	1562
-63.9	-83	-117.4	-25.0	-13	8.6	13.3	56	132.8	52.2	126	258.8	91.1	196	384.8	460	860	1580
-63.3	-82	-115.6	-24.4	-12	10.4	13.9	57	134.6	52.8	127	260.6	91.7	197	386.6	466	870	1598
-62.8	-81	-113.8	-23.9	-11	12.2	14.4	58	136.4	53.3	128	262.4	92.2	198	388.4	471	880	1616
-62.2	-80	-112.0	-23.3	-10	14.0	15.0	59	138.2	53.9	129	264.2	92.8	199	390.2	477	890	1634
-61.7	-79	-110.2	-22.8	-9	15.8	15.6	60	140.0	54.4	130	266.0	93.3	200	392	482	900	1652
-61.1	-78	-108.4	-22.2	-8	17.6	16.1	61	141.8	55.0	131	267.8	98.9	210	410	488	910	1670
-60.6	-77	-106.6	-21.7	-7	19.4	16.7	62	143.6	55.6	132	269.6	100	212	413	493	920	1688
-60.0	-76	-104.8	-21.1	-6	21.2	17.2	63	145.4	56.1	133	271.4	104	220	428	499	930	1706
-59.5	-75	-103.0	-20.6	-5	23.0	17.8	64	147.2	56.7	134	273.2	110	230	446	504	940	1724
-58.9	-74	-101.2	-20.0	-4	24.8	18.3	65	149.0	57.2	135	275.0	116	240	464	510	950	1742
-58.4	-73	-99.4	-19.5	-3	26.6	18.9	66	150.8	57.8	136	276.8	121	250	482	516	960	1760
-57.8	-72	-97.6	-18.9	-2	28.4	19.4	67	152.6	58.3	137	278.6	127	260	500	521	970	1778
-57.3	-71	-95.8	-18.4	-1	30.2	20.0	68	154.4	58.9	138	280.4	132	270	518	527	980	1796
-56.7	-70	-94.0	-17.8	0	32.0	20.6	69	156.2	59.4	139	282.2	138	280	536	532	990	1814
												143	290	554	538	1000	1832

Tenney ENGINEERING, INC.
1090 SPRINGFIELD ROAD, UNION, N. J.
Plants: Union, N. J. and Wilmington, N. C
Oldest and Largest Manufacturer of Environmental Equipment

WARRANTY ON REPLACEMENTS

All warranty replacements for chamber components must be cleared through Tenney Engineering, Inc., Service Department, 1090 Springfield Road, Union, New Jersey. Failure to do so may result in loss of warranty on the particular component involved.

MP MASTER
MA29083